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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/859,437	05/18/2001	Peter William Mitchell Ilbery	169.2060	3713

5514 7590 12/15/2004

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EXAMINER	
QIN, YIXING	
ART UNIT	**PAPER NUMBER**
2622	

DATE MAILED: 12/15/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/859,437	ILBERY ET AL.	
	Examiner	Art Unit	
	Yixing Qin	2622	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *18 May 2001*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-32* is/are pending in the application.

4a) Of the above claim(s) *30-32* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-29* is/are rejected.

7)☒ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *18 May 2001* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

Claim Objections

Claims 1 objected to because of the following informalities: The word "term" as used multiple times in the claim limitations is unclear as to its relation to the nozzle. From the specification, paragraph 4 states that nozzles can either be blocked or merely defective in terms. Thus, the examiner will use the definition of term as being equivalent to blocked or defective. If this is the incorrect understanding of the word, please provide appropriate documentation to define the word term as used in the application.

Claims 30, 31 and 32 are objected to under 37 CFR 1.75(c) as being in improper form because a multiple dependent claim cannot depend on other multiple dependent claims. See MPEP § 608.01(n). Accordingly, the claims 30, 31 and 32 not been further treated on the merits.

Claim Rejections - 35 USC § 102

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

I. Claim 13 is rejected under 35 U.S.C. 102(b) as being anticipated by Hines (U.S. Patent No. 6,034,782)

1. **Claim 13**

- **adjusting a relationship between input image values and corresponding average halftone output values using an error diffusion table.**
- Hines discloses in Fig. 2 and column 3, lines 33-37 that Fig. 2 shows "...a flow chart of...a cable test routine in an inkjet printer which uses a downloaded error diffusion table to convert a multi image to a half-tone image."

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

II. Claims 1-5 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hickman (U.S. Patent No. 4,963,882).

The Hickman reference discloses a printing technique that uses multiple nozzles to print a single pixel of an image.

2. **Claim 1**

- **biasing, for each first image value associated with a first nozzle, at least one second image value associated with another nozzle, said biasing being dependent upon said first image value and a term for said first nozzle;**

- Hickman discloses in Fig. 7, Fig. 8 and column 8, lines 41-63 a method for compensating for a defective nozzle. In particular, in lines 50-52, Hickman discloses that "[t]wo dots are deposited on each pixel location, each droplet being ejected from a different nozzle." Although Hickman does not explicitly state the **image value** (as understood by the examiner to mean the intensity or density of ink drops on a dot or pixel) of the pixels of the blank row, one would understand it would be zero since there was no ink deposited by the defective nozzle.

- Regarding the **term**, Hickman discloses above that the **first nozzle**, is a defective nozzle

- **and printing the image in accordance with the biased image values, said biasing reducing print artefacts otherwise caused by the one or more defective nozzles.**
- In the same lines as mentioned above, Hickman disclosed that the blank line (**artifact**) is effectively covered by ink. Also, see Fig. 9 and column 8, lines 64-67 and column 9, lines 1-10 for further discussion of the effectiveness of Hickman's compensation technique.

3. Claim 2

A method according to claim 1,

- **the term for said first nozzle provides a measure of one of effectiveness and defectiveness of said first nozzle.**

- As stated above in the claim 1 rejection, Hickman discloses that the **first nozzle** is a defective nozzle.

4. Claim 3

A method according to claim 1, said biasing comprises the sub-step of:

- **redistributing one of part of said first image value and all of said first image value to one or more image values associated with immediately neighbouring nozzles of a same colour.**
- Regarding claim 3, the examiner assumes that all of the first image value is redistributed since the redistributing of one of part and then all of said first image value is the same as simply saying redistributing all of said first image value.
- Hickman discloses in column 2, lines 25-39 "...a process for depositing two dots of a single colorant onto a printing medium at a single selected pixel location...[includes] a first colorant delivery nozzle and a second colorant delivery nozzle..." Furthermore, in column 4, lines 50-54, Hickman discloses that "...if an individual nozzle fails, the dot to be printed by that nozzle will still be printed [by] the second nozzle assigned to a droplet at the selected location..." Although Hickman makes no indication of the proximity of the nozzles to each other, it would make sense for them to be close together since they are printing at the same location.

5. Claim 4

- **an extent of image value redistribution is dependent upon an allowed operating range of the one or more image values associated with said immediately neighbouring nozzles.**
- Using the Hickman reference, the extent of the redistribution would be understood to be 100% since a defective nozzle does not produce any ink at all. The neighboring or second nozzle that is supposed print at the same location would instead print a dot, effectively depositing all of the ink that is supposed to be at that particular location or pixel. Since the second nozzle is supposed to make the same dot at the same location, one would understand the **operating range** of both nozzles are the same.

For example, the abstract discloses that "...multiple droplets of colorant of the same color are deposited upon a single pixel location from two different nozzles." Each droplet creates a certain image value upon the printing medium, and when one is effective, the entire image value at that point would be created from the non-defective nozzle.

6. **Claim 5**

- **said allowed operating range of said image values is between 0% and 100%, wherein 100% represents a maximum intensity for unbiased image values.**
- As mentioned in the claim 1 rejection above, the failure of a nozzle leads to a deposit of no ink (**0% image value**). Further a working nozzle would deposit a

droplet of ink onto a print medium (assumed to be **100% image value** since for an unbiased value, there is no need for compensation for a defective nozzle)

III. Claims 6-9 rejected under 35 U.S.C. 103(a) as being unpatentable over Hickman (U.S. Patent No. 4,963,882) in view of Suzuki et al (U.S. Patent No. 6,036,300)

The Suzuki et al reference discloses an image recording apparatus using multi-scanning to print images to eliminate artifacts produced by defective nozzles.

7. Claim 6

A method according to claim 4,

- **whereby said allowed operating range of said image values is between 0% and 200%, wherein 100% represents a maximum intensity for unbiased image values, and 200% represents a super-intensity for biased image values.**
- Although the Hickman reference discloses (as seen in the rejection to claim 5 above) that the nozzles in his invention will either deposit or not deposit a drop depending on the defectiveness of the nozzle, it does not disclose that the ejection of the ink can exceed 100% density.

The Suzuki et al reference disclosed the idea of using other nozzle(s) to compensate for defective nozzles as well. In addition, in column 18, lines 18-27, Suzuki et al discloses that "...the maximum recording density becomes 1.5 when

the maximum value of the image data is FFH." Although 1.5 is an indication of 150%, it is clear that one can simply increase this amount by setting a threshold at a higher value (i.e. 2 or 200%)

Since both references are in the art of printing and image correction, it would be obvious to one of ordinary skill in the art at the time of invention to allow Hickman's invention to have nozzles that print at above 100% intensity. The motivation would be to have more image evenness since printing 200% intensity dots from one nozzle could is effectively the same as printing two 100% intensity dots from different nozzles.

8. Claim 7

A method according to claim 1,

- **whereby said biasing comprises the sub-steps of: increasing an image value associated with a corresponding nozzle of another colour.**
- The Hickman reference discloses in column 3, lines 59-62 that "[d]ots of secondary colors are formed by overprinting two dots of primary colors, wherein each dot is printed using two or more droplets of each primary color, each droplet being from a different nozzle." This means that a dot of a secondary color has a total of at least four nozzles associated with it (two drops from two different nozzles of a first primary color plus two drops from two nozzles of a second primary color). However, the Hickman reference does not indicate that the intensity of the drops could increase above 100%.

As mentioned above in the rejection to claim 6, the Suzuki reference disclosed that the maximum density of an ejected drop could reach 1.5 or 150% density. If one of the nozzles were to fail, then two drops of a primary color would be deposited and one drop of the other primary color would be deposited according to the Hickman reference. If the ability to print at 150% density of the other primary color that only has one dot instead of two, the degradation of the dot being printed would be even less significant. As mentioned above in the rejection to claim 6, both reference are in the same art and endeavor areas, and the improvement would enable less image degradation.

9. Claim 8

A method according to claim 1, whereby said biasing comprises the sub-steps of:

- **redistributing one of part of said first image value and all of said first image value associated with said first nozzle to one or more image values associated with immediately neighbouring nozzles of a same colour;**
- This limitation was addressed in the rejection to claim 3 above.
- **and increasing an image value associated with a corresponding nozzle of another colour, said increase being dependent upon a residual image value of said first nozzle after said redistribution step.**
- The residual value of the first nozzle (defective) would be 0 since all of the said first image value is redistributed (see rejection to claim 3 above for explanation). This limitation is also addressed in the rejection to claim 7.

10. Claim 9

A method according to claim 6 comprising, prior to printing the image, the sub-step of:

- **mapping the biased image values from a biased image value range of 0% to 200%, to a range of 0% to 100%.**
- The goal of the mapping process is to reduce the complexity in the unevenness correction process as stated in line 22 of page 18 of the specification.
- The Suzuki reference discloses in column 18, lines 58-62 that "...the image data is multiplied by 1/1.1 (=0.91) [because the density of the printed dot is 10% too dense as explained in column 18, lines 38-57]...[and] the image density to be recorded by the Y portion 412 of the recording head 401 can be equalized to the estimated density." Of course, if the density is assumed to be much higher (say at 200%) then one can multiply the density by ½ to reach 100%. This multiplication of a factor effectively rescales the amount of depositing of ink to a density level that is closer to the one specified in the image data.

IV. Claim 10 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hickman (U.S. Patent No. 4,963,882) in view of Suzuki et al (U.S. Patent No. 6,036,300) and further in view of Semasa (U.S. Patent No. 5,418,626)

Semasa discloses a quantization process used in the reduction of images.

11. Claim 10

A method according to claim 9, whereby said mapping uses checkerboard quantisation, said method comprising the steps of:

- **dividing said biased image values by 2; and alternately rounding successive divided image values up, and down.**
- Both the Hickman and Suzuki et al references deal with error correction, but neither discloses a checkerboard quantizing.
- The Semasa reference discloses a quantizer (item 4 of Fig. 5) and in Fig. 6b shows a ¾ image of an image after having been quantized. In column 3, lines 26-27, the description shows that figure 6b is a black and white checkerboard test pattern of an original image. Furthermore, in column 5, lines 39-45, Semasa discloses that "[i]n FIG. 1, an image signal memory 1 temporarily stores the input image signal S1. An enlargement/reduction calculator circuit 2, coupled to the image signal memory 1 to receive the output S2 thereof, effects a weighting calculation at a 8-bit precision in accordance with the magnification rate (enlargement/reduction factor)." Furthermore, Semasa discloses in column 4, lines 63-67 and column 5, lines 1-5, that their invention has a "...quantizer 4 [that] quantizes the compensated grey level C_{XY}...by thresholding, for example, at ½, and thereby obtains the output image signal S5 representing the quantized binary level O_{XY}...[and that the] binary level O_{XY} is determined by :

O_{XY} = 1 where $C_{XY} \geq ½$ and

O_{XY} = 1 where $C_{XY} < ½$ and

This method of rounding up and down by Semasa is to allow 8-bit representation of numbers without having to deal with decimal places. Since all three references are in the art of image processing and error correction, it would be obvious to one of ordinary skill in the art at the time of the invention to improve Hickman's invention with nozzle compensation techniques as disclosed by Suzuki et al and the quantizing technique as disclosed by Semasa. The motivation would be to provide a method for the representation of decimal values without decimal places using eight binary digits and maintaining a constant density over an area.

IV. Claims 11 and 12 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hickman (U.S. Patent No. 4,963,882) in view of Suzuki et al (U.S. Patent No. 6,036,300) and further in view of Yen et al (U.S. Patent No. 5,992,962)

The Yen et al reference discloses a print mask technique for reducing artifacts in ink jet printing.

12. Claim 11

A method according to claim 6, comprising, prior to printing the image, the sub-step of:

- **halftoning the biased image values.**
- Both the Hickman and Suzuki et al references disclose error correction techniques, but does not explicitly disclose any techniques associated with halftoning.
- The Yen et al reference discloses in column 4, lines 34-38, that their invention uses "...a unique print mask that...uses nozzles along the outer edges of the black print head to print in place of defective interior nozzles, while applying such techniques as halftoning techniques to smooth the transition from each printing pass." Furthermore, in column 5, lines 32-33, Yen et al discloses that "[t]he mask herein described is implemented in the control signals applied to the print head," and in column 6, lines 38-39 that "[in their] invention, a halftone-like pattern is applied to the print mask."

  Since all three references are in the art of printing and image correction, it would be obvious to one of ordinary skill in the art at the time of the invention to apply a halftoning technique in addition Hickman's invention. The motivation would be to provide further image smoothing and unevenness-correction before the printing process has begun.

13. Claim 12

A method according to claim 11,

- **whereby, in a multi-level halftoning, process, a relationship between an input image value and a corresponding average halftone output value is adjusted in order to tune a utilisation of super-intensity printing.**
- The Hickman reference fails to disclose an adjustment mechanism between an input and an output value. The Suzuki reference discloses in Fig. 24 and column 19, lines 6-12 that the process explained in the previous paragraphs (column 18, lines 58-67, and column 19, lines 1-5 of Suzuki et al) of density adjustment is controlled by gamma control units. Although Suzuki et al does disclose the relationship of an input value to an output value as well as the idea of super-intensity printing (i.e. having a maximum density of 1.5, column 18, line 26), it does not disclose halftoning. Neither reference discloses anything about halftoning. However, the tertiary reference, Yen et al, discloses the idea of halftoning (see rejection to claim 11 above).

Since all three references are in the art of printing and image correction, it would be obvious to one of ordinary skill in the art at the time of the invention to apply a halftoning technique in addition Suzuki et al's input/output value relationship density adjustment technique to Hickman's invention. The motivation would be to provide a way for easier extrapolation or conversion of values for printing a density of higher than normal.

V. Claims 14-27 rejected under 35 U.S.C. 103(a) as being unpatentable over Suzuki et al (U.S. Patent No. 6,036,300)

14. Claim 14

- **(a) a plurality of forming elements for forming an image according to input image forming signals**
- Suzuki et al discloses in column 6, lines 6-12, that "[t]he ink jet head includes a plurality of nozzle arrays...and has a mechanism to selectively eject ink from the nozzle arrays in accordance with the image signals transmitted from an image processing unit..."
- **(b) memory means for storing data for said forming elements indicating the relative desirability of utilising said forming elements for forming an image**
- Suzuki et al discloses in Fig. 14 the structure of a printer of an embodiment of their invention which includes a RAM 432 and supplemental data 433. In column 14, lines 17-23, that " [a] CCD sensor [is used to determine]...if the dots actually recorded and the image data to be recorded are not coincident, such a portion is designated as 1 and recorded in the complementary data area 433 of the RAM 432..." The storage of a 1 is essentially used to indicate that the nozzle associated with printing this dot is defective and failed to print a dot when it was supposed to. A more complete description of the printing process can be seen in column 13, line 62 to column 15, line 8.

This process is recording the portions where a recorded dot does not match the image data to be recorded, which, in essence, identifies a defectively printed dot. It would be clear that one could, alternatively, make a record of dots not recorded (i.e. matching an unrecorded dot to the image data). This would enable easier identification of nozzles that failed to record a dot. This would be a matter of design depending on whether it would be necessary to strictly identify nozzles that are unable to deposit any ink at all.

- **(c) image processing means for computing image recording signals using said input image forming signals and said data stored in said memory means where the use of a forming element is biased using the relative desirability data of other forming elements.**
- Suzuki discloses in column 15, lines 4-8, that "...even when the nozzles of defective ink ejection exist in the X portion 411 of the recording head 401, it is possible to record the dots corresponding to such nozzle portion by the use of the other nozzles in the subsequent recording process."

Furthermore, in column 13, a line 49-61, Suzuki explains how unprinted dots are made up for by printing them using a different nozzle in the print head. In particular, on lines 58-60, "...the dots which are not recorded by the nozzles X1 are recoded by the nozzles Y1 of the recording head 401."

15. Claim 15

- **(a) a plurality of forming elements for forming an image using image recording signals, said image according with a corresponding plurality of input image forming signals**
- **(b) memory means for storing data for said forming elements indicating the relative desirability of utilising said forming elements for forming the image**
- **(c) image processing means for computing said image recording signals using said input image forming signals and said data stored in said memory means, wherein the use of a particular forming element is thereby biased dependent upon the relative desirability data of other forming elements, the corresponding input image forming signal for the particular forming element, and a term for the particular forming element.**
- Claim 15 is almost the same as claim 14, with the addition of the dependence of the biasing of a particular forming element based further upon a corresponding input image forming signal and a term.
- Suzuki et al discloses in column 6, lines 6-12, that "[t]he ink jet head includes a plurality of nozzle arrays...and has a mechanism to selectively eject ink from the nozzle arrays in accordance with the image signals transmitted from an image processing unit..." (as stated above in the rejection to claim 14) . The ability to selectively eject ink indicates that particular nozzles are activated or deactivated depending on the image being printed. As far as the "**term**" is concerned, this related to the effectiveness or defectiveness of a nozzle, which would be implied

by the storage of a "1" in the complementary storage area as stated above in the claim 14 rejection.

16. Claim 16

- **(a) a plurality of forming elements for forming an image according to input image forming signals;**
- **(b) memory means for storing data for said forming elements indicating the relative desirability of utilising said forming elements for forming an image;**
- **(c) image signal modification means for redistributing values of said input image forming signal based on said data stored in said memory means so as to bias the use of said forming elements.**
- The first two limitations of claim 16 were addressed in the rejections to claim 14 above. Regarding the third limitation of claim 16, it was also pointed out in the rejection to claim 14, that there is selective ink ejection from nozzles based on signals. Thus, to have other nozzle(s) compensate for a defective nozzle that did not eject any ink, there has to be a signal sent to the other nozzle(s) in order to print the dot. One example of defective nozzle compensation would be in column 15, lines 22-35.

17. Claim 17

- **(a) a plurality of forming elements for forming an image according to input image forming signals;**

- **(b) memory means for storing data for said forming elements indicating the relative desirability of utilising said forming elements for forming an image;**
- **(c) image signal modification means for redistributing values of said input image forming signals based on said data stored in said memory means so as to bias the use of said forming elements, wherein the use of a particular one of said forming elements is thereby biased dependent upon the relative desirability data of other forming elements, a corresponding input image forming signal for the particular forming element, and a term for the particular forming element.**
- The first two limitations of claim 17 were addressed in the rejections to claim 14 above. The third limitation of claim 17 is a combination of the third limitation of claim 15 and the third limitation of claim 16. Please see the rejection to those above.

18. Claim 18

An image recording apparatus according to claim 16 where:

- **said image signal modification means for redistributing values of said input image forming signals does not extend the range of said values.**
- As disclosed in the rejection to claim 16 above, the nozzle compensation technique is simply an ejection of a similar dot by another nozzle to compensate for the failure of a previous nozzle to eject a dot. It would make sense that the

nozzles be uniform in nature and that the amount of ink in ejected by the working nozzle would be the same as the defective nozzle (i.e. not eject more ink than needed).

19. Claim 19

An image recording apparatus according to claim 14 where:

- **said apparatus is a colour image recording apparatus, said plurality of forming elements including plural groups of forming elements respectively corresponding to colour components.**
- Suzuki et al discloses in column 5, lines 50-55, that their invention has an "...ink jet recording unit A-2 (Fig. 9) which ejects four color in materials..."

20. Claim 20

An image recording apparatus according to claim 19 where:

- **said image processing means includes means for modifying the input image forming signals relating to a colour component based on said input image forming signals and based on said data indicating the relative desirability of utilising said forming elements relating to other colour components.**
- The rejection to claim 14 addressed the desirability of using another nozzle because of the defectiveness of a particular nozzle. Claim 20 simply adds that color nozzles could be used. Since the invention of Suzuki et al is capable of

color printing as disclosed in the rejection to claim 19 above, it would be clear that the nozzles being used are capable of ejecting color.

21. Claim 21

An image recording apparatus according to claim 16 where:

- **said apparatus is a colour image recording apparatus, said plurality of forming elements including plural groups of forming elements respectively corresponding to colour components.**
- Please see the rejections to claim 16 and claim 20.

22. Claim 22

An image recording apparatus according to claim 21 further comprising:

- **image processing means for modifying said redistributed input image forming signals relating to a colour component based on said redistributed input image forming signals and based on said data indicating the relative desirability of utilising said forming elements relating to other colour components.**
- The rejections to claims 14, 16 addressed the processing means based on data. The rejection to claim 20 and 21 above addressed the color component.

23. Claim 23

An image recording apparatus according to claim 16 where:

- **said forming elements are capable of recording a "super" density being greater than any density recorded by said forming elements when no image forming signal values are redistributed by said image signal modification means;**
- Suzuki et al discloses in column 18, lines 18-33 the comparison of the density of an actual recorded dot to that of the recording (image) data. Furthermore, in column 18, lines 44-47, Suzuki et al discloses an example explain that "[t]he recording is performed at a density which is higher than the estimated density by 10%." This is an indication that a nozzle can print at a higher density than what is needed to be recorded.
- **and said image signal modification means is capable of biasing the use of said forming elements to record said super density.**
- Suzuki discloses in column 18, lines 53-58, that "...if the recording is performed each by the Y portion 412 and Z portion 412 of the recording head 401 without any correction, the recorded density is higher than the estimated density by 10% as in the case of the recording in the X portion 411."

From previous rejections, it was known that there would be compensation for defective nozzles by printing dots from another nozzle. Both nozzles could be printing in the same portion and would both be printing 10% more density.

24. Claim 24

An image recording apparatus according to claim 23 where:

- **redistribution of values of said input image forming signals is capable of extending the range of said values.**
- Suzuki et al discloses in column 18, lines 23-27 that "[the] recording density is estimated as 0.75 in a case of a printing apparatus where the maximum recording density becomes 1.5 when the maximum value of the image data is FFH, for example." This indicates that the nozzles of Suzuki et al's reference are able to print a variable range depending on the density of the image to be printed.

25. Claim 25

An image recording apparatus according to claim 24 further comprising:

- **image processing means for re-mapping said redistributed image forming signals so that the range of said values is restored to the range existing prior to said redistribution.**
- Suzuki et al discloses in column 18,lines 58-67 and column 19, lines 1-4, processing for averaging densities of X, Y, and Z printed portions so that the average density of the area printed is the same as the recording or image data. From the rejection to claim 23 above, Suzuki et al pointed out that the various portions printed different densities. The multiplication by a factor of 0.91 (column 18, line 59) to the portions with the increased densities brings the density of the printed area down. Thus the average over the entire area having X, Y and Z portions is the same as the image data.

26. Claim 26

An image recording apparatus according to claim 24 where:

- **said image processing means map redistributed image forming signals to the range existing prior to said redistribution by maintaining distinct local average image values for image regions with differing constant input image signal value.**
- This method of averaging is discussed in the rejection to claim 25 above. The X, Y and Z portions have differing densities, but the average for the image region is still "1." (Suzuki et al, column 19, lines 1-4)

VI. Claim 27 is rejected under 35 U.S.C. 103(a) as being unpatentable over Suzuki et al (U.S. Patent No. 6,036,300) in view of Semasa (U.S. Patent No. 5,418,626) and further in view of Yen et al (U.S. Patent No. 5,992,962)

27. Claim 27

An image recording apparatus according to claim 26 where:

- **said image processing means map redistributed image forming signals to the range existing prior to said redistribution by substantially dividing image values by 2 and alternately rounding up and rounding down.**
- Since the Suzuki et al reference has the ability to multiply the density of the image data to be recorded for the various X, Y and Z portions, they could simply

use factors of 0.5 and 2 for alternating regions in order to accomplish the same job as being done according to claim 27. Furthermore, the Semasa reference discloses a quantizing method using rounding (see rejection to claim 10 above).

VII. Claim 28 is rejected under 35 U.S.C. 103(a) as being unpatentable over Suzuki et al (U.S. Patent No. 6,036,300) in view of Semasa (U.S. Patent No. 5,418,626) and further in view of Yen et al (U.S. Patent No. 5,992,962)

28. Claim 28

An image recording apparatus according to any of claims 24 to 27 further comprising:

- **halftoning means which generate recording element signals so that the frequency of occurrence of super density recording by recording elements is adjusted according to halftoning parameters.**
- The Suzuki et al reference discloses that there are signals associated with the operation of the nozzles as mentioned in the claim 14 rejection above and super intensity recording as mentioned in the claim 23 rejection above. However, the Suzuki et al reference does not explicitly disclose that the means that generates these signals is halftone in nature.
- The Semasa reference discloses halftoning, but does not explicitly disclose that they have some parameters that control or adjust the frequency of super-intensity printing.

The Yen et al reference discloses in column 4, lines 34-38, that their invention uses "...a unique print mask that...uses nozzles along the outer edges of the black print head to print in place of defective interior nozzles, while applying such techniques as halftoning techniques to smooth the transition from each printing pass." Furthermore, in column 5, lines 32-33, Yen et al discloses that "[t]he mask herein described is implemented in the control signals applied to the print head," and in column 6, lines 38-39 that "[in their] invention, a halftone-like pattern is applied to the print mask."

Since both the Suzuki et al and Yen et al references are in the art of the correction of artifacts in images, it would be obvious to one of ordinary skill in the art at the time of the invention to add a halftoning and masking technique as disclosed by Yen et al to Suzuki et al's invention. The motivation would be to provide more functionality to Suzuki et al's invention by allowing it to correct images with using masks in addition to multi-scanning.

VIII. Claim 29 is rejected under 35 U.S.C. 103(a) as being unpatentable over Suzuki et al (U.S. Patent No. 6,036,300) in view of Semasa (U.S. Patent No. 5,418,626), in view of Yen et al (U.S. Patent No. 5,992,962) and further in view of Hines (U.S. Patent No. 6,034,782).

29. Claim 29

An image recording apparatus according to claim 28 where:

- **said halftoning means generate recording element signals by error diffusion processing such that the frequency of occurrence of super density recording by recording elements is adjusted according to values in an error diffusion table.**
- As mentioned in the claim 13 above, the Hines reference discloses a method of using an error diffusion table for value adjustments. Since all three references are in the art of printing, it would be obvious to one of ordinary skill in the art at the time of invention to add an error diffusion table as disclosed by Hines and halftone masking techniques as disclosed by Yen et al to Suzuki et al's invention. The motivation would be to allow Suzuki et al's invention to more accurately correct artifacts in images.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Yixing Qin whose telephone number is 703-306-4142. The examiner can normally be reached on M-F 8:00-4:30.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Edward Coles can be reached on 703-305-4712. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

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YQ